The Journey Continues – Improving Process Control for the Space Shuttle Program

Quality Leadership Forum
July 17-19, 2001

Ron Lang for

Joyce Rozewski

NASA Space Shuttle Program Office

Background

- Process control problems have caused delays and mission impacts to Shuttle Program
  - ➢ Hatch latch actuator problem prevents EVA, STS-80
  - ➢ Contaminated cleaning cloth causes extensive testing and analysis before launch of STS-103

Shuttle Program Manager Concern

- Safety Risk
- Need to Improve Process Control across SSP

PROCESS CONTROL
Mission Success Depends On You

Process Control Initiative

Team & Mission Statement

NASA:
Johnson Space Center (Lead)
Kennedy Space Center
Marshall Space Flight Center
Stennis

Contractors:
United Space Alliance
Lockheed Martin Michoud (ET)
Rocketdyne Propulsion (SSME)
Hamilton Sundstrand (EMU)
Pratt & Whitney (Turbo Pump)
Thiokol (RSRM)

Ground Operations
Flight Operations
Integrated Logistics
Solid Rocket Boosters
Flight Crew Equipment
Program Integration
Flight Software
Orbiter (Boeing)

"Reduce Space Shuttle Program Risk by Preventing Process Escapes"

PROCESS CONTROL
Mission Success Depends On You

Process Control Initiative

Strategy

Target the Top Causes of Process Escapes

PROCESS CONTROL
Mission Success Depends On You

Team Developed Solutions

PROCESS CONTROL
Mission Success Depends On You

- *Determine **best practices** for process control used across program*
- *Create program process control **standards** from these best practices*
- *Communicate process control **lessons learned** across program elements*
- *Increase **awareness** of importance of process control across all levels of Shuttle Program*

CHALLENGE:

✓Large Supplier Base - >850 Active Suppliers of Flight Hardware Across 50 States

✓Thousands more 2nd and 3rd Tier Suppliers

Root Causes Determined

➢ Changes at Suppliers Not Adequately Assessed and Technically Verified

- Seemingly minor changes to “noncritical” processes causing significant problems
- Existing Quality Systems, ISO 9000, contractual requirements inadequate to protect against some changes
- Rigorous control over critical processes

Contributing Factors

- **Process drift over time**
- **Unreported, well-intentioned process improvements**
- **Changes caused by environmental regulations**
- **Business realignments**
- **Aging program/Loss of corporate knowledge**

PROCESS CONTROL
Mission Success Depends On You

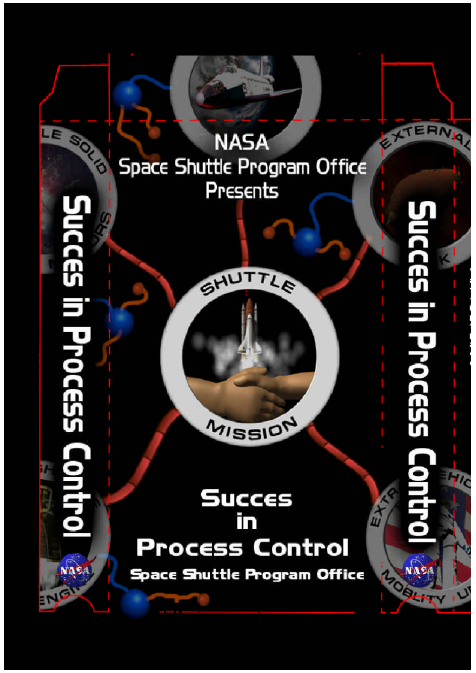
Process Control Standards

PROCESS CONTROL
Mission Success Depends On You

- Provide for early detection of process variability and uncoordinated changes
- Eliminate process “creep”
- Understand and mitigate process risks
- Identify critical characteristics and processes to control
- Enforce personal accountability to perform exactly per written procedures
- Promote awareness of process control
- Identify and evaluate changes to equipment and environment
- Capture and maintain process knowledge and skills.

Process Control Management Plan Approved by All Prime Contractors

Supplier Awareness



Videos

Widespread Distribution – To All Major Suppliers This Year

Well Received – Positive Feedback

Follow on COUNTDOWN video: In Production

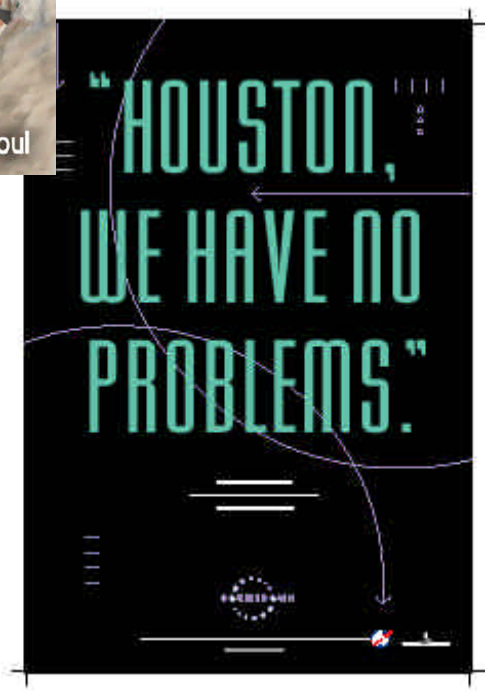
www.countdownonline.tv

Supplier Visits and Symposiums

Joint Visits for Common Suppliers

Astronaut Support and Space Flight Awareness

Posters and Brochures



Posters

11,000 Posters printed in support of the two videos

Distribution to all major suppliers with videos

Follow on posters in design phase

Supplier Brochures

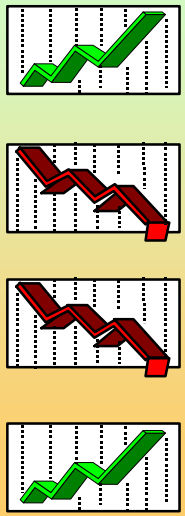
Increasing use of supplier brochures by all primes

PROCESS CONTROL
Mission Success Depends On You

Metrics Indicate Program Success

- Process Escapes
- Corrective Actions
- Lessons Learned
- Awareness Activity

Reported Quarterly to Program Manager



Culture Change Requires Long-Term Commitment

PROCESS CONTROL
Mission Success Depends On You

Summary

Government & Industry Process Control Focus Group

Program Process Concerns

Standardize Program Level Performance Reporting

- Quarterly Program Reviews
- Focus Group
- Process Control Plan

Communication	Best Practices	Performance Indicators
• Lessons Learned • Supplier Visits • Video • Posters	• Process FMEA • PPIA's • Personal Warranty • Process Mapping	• Inspection Results • Preventive/Corrective Action • Audits • Awareness

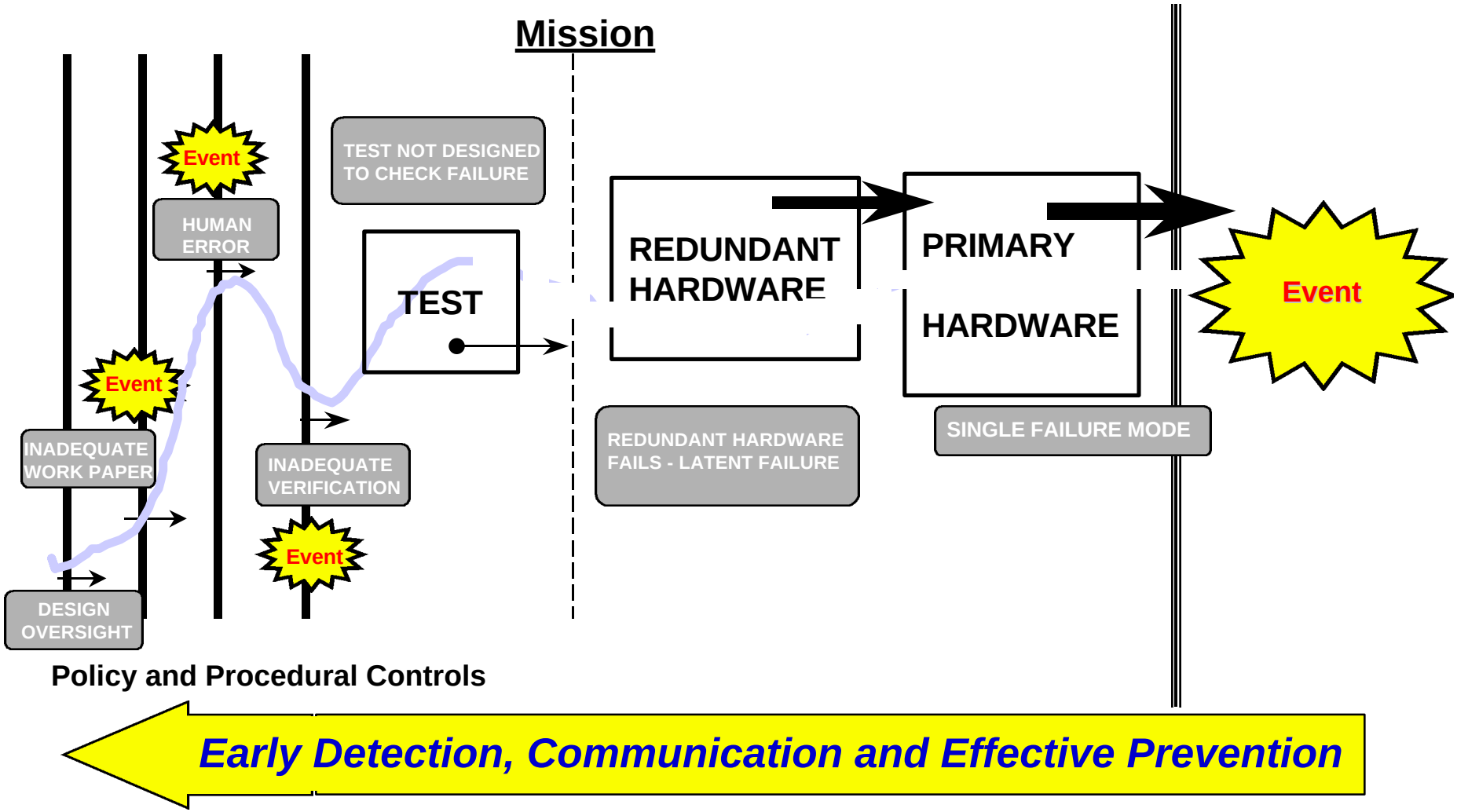
PROCESS CONTROL
Mission Success Depends On You

Backup and Examples

PROCESS CONTROL
Mission Success Depends On You

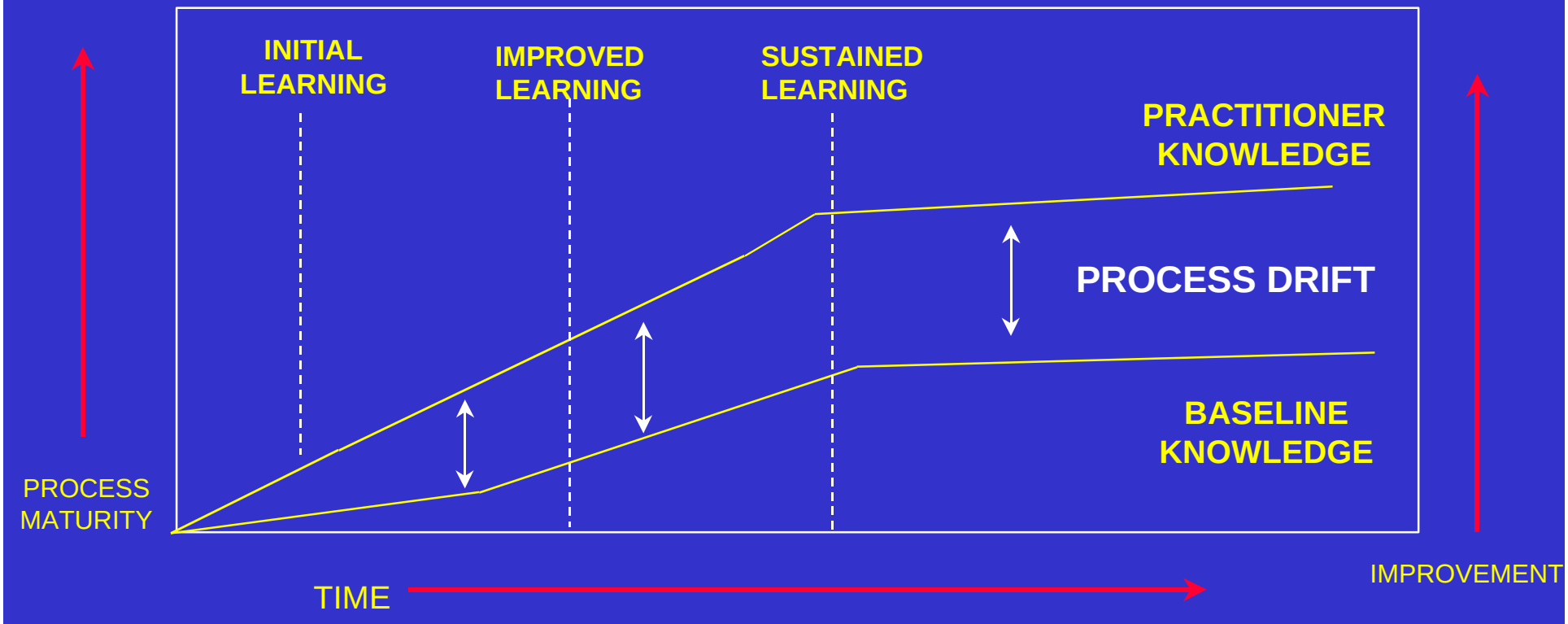
Event Chain

Failures snake their way through the system designed to protect



PROCESS DRIFT

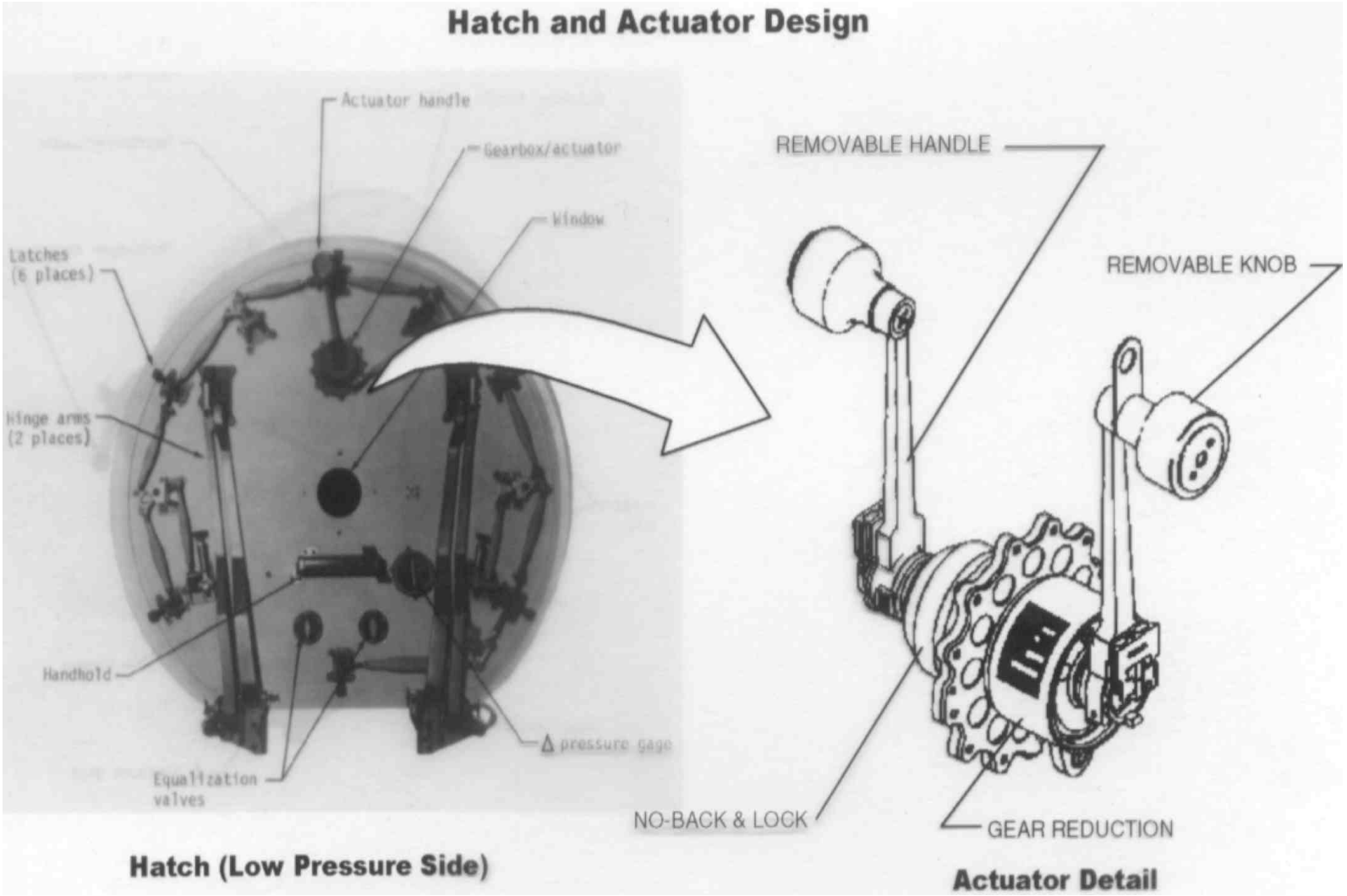
Traditional Audit Systems Don't Protect Against Drift



Need To Leverage Practitioners Knowledge

HATCH ACTUATOR

EXAMPLE

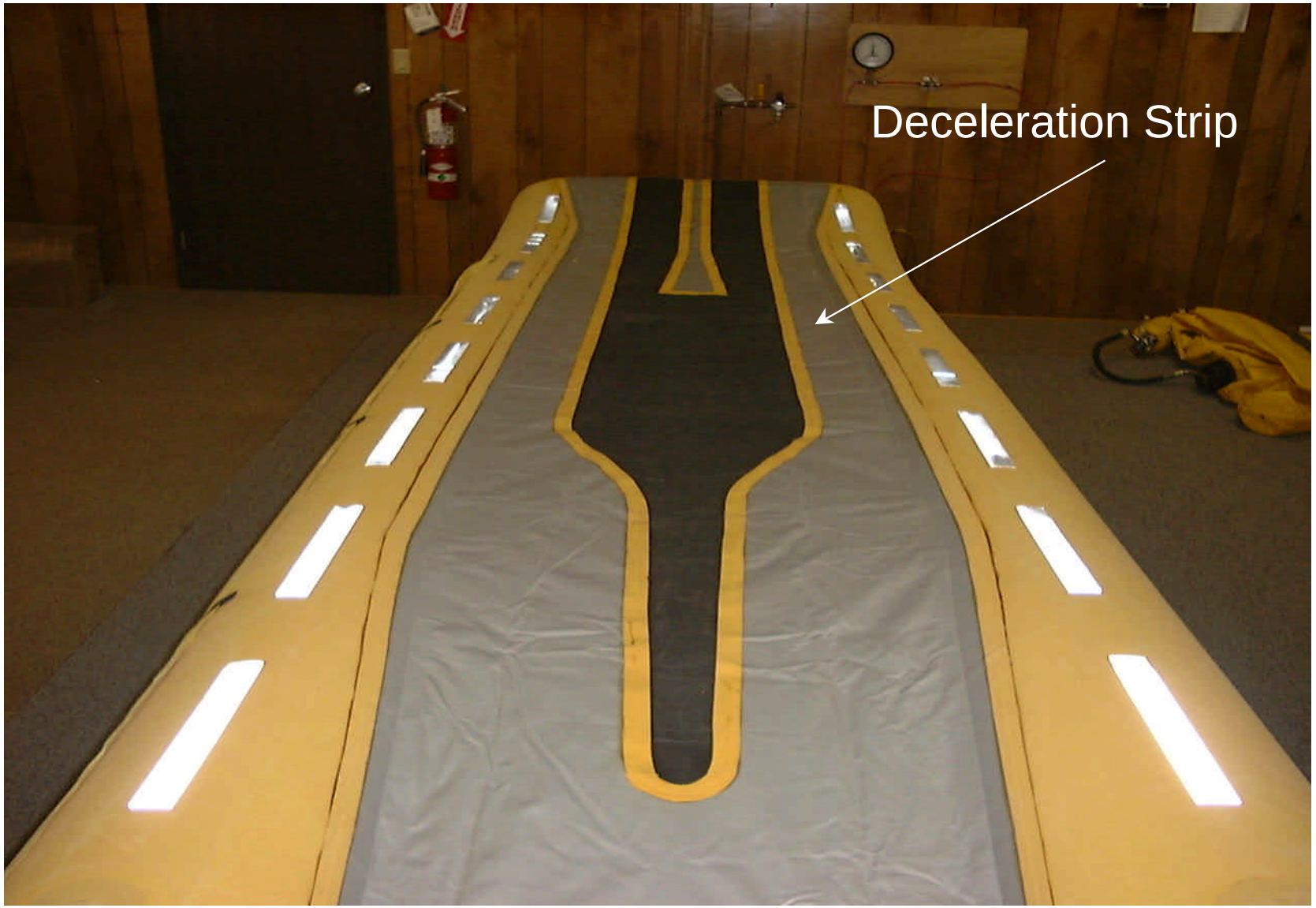


HATCH ACTUATOR

EXAMPLE

EMERGENCY EGRESS SLIDE

EXAMPLE



ELECTRICAL CONNECTOR

EXAMPLE